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THE CALLS AND TAXONOMIC POSITIONS OF *HYLA GIESLERI* AND *OLOLYGON OPALINA* (AMPHIBIA: ANURA: HYLIDAE)

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Abstract.—The advertisement calls of *Hyla giesleri, H. microps, Ololygon catharinae* and *O. opalina* are described. The call data together with morphological differences indicate that *Hyla giesleri* is a species distinct from *H. microps,* with which it is currently placed, and that *Ololygon opalina* is a full species, not a subspecies of *Ololygon catharinae* as originally described. The calls in each species pair differ in several species specific coding features; small behavioral and morphological adjustments can account for these differences.

Field recordings of advertisement calls of frogs from southeastern Brazil clarify the taxonomic positions of two species of hylid frogs, *Hyla giesleri* and *Ololygon opalina*. Duellman (1977) and Lutz (1973) included *Hyla giesleri* Mertens in the synonymy of *Hyla microps* Peters, following the synonymy of Bokermann (1966). Lutz (1968) described *opalina* as a new subspecies of *Hyla catharinae.* Lutz (1973) and Duellman (1977) maintained this relationship. I follow Fouquette and Delahoussaye (1977) and consider *catharinae* a member of the genus *Ololygon*. The data presented in this paper demonstrate that *Hyla giesleri* is specifically distinct from *Hyla microps* and that *Ololygon opalina* is a distinct species within the *Ololygon catharinae* complex.

Methods and Materials

Field recordings made with an Uher CR-134 stereo cassette recorder were analyzed using a Kay Sonagraph model 6061 B, a Hewlett Packard 7402A strip chart recorder and a Brüel and Kjaer 2121 frequency analyzer. Specimens are deposited in the Museu de Zoologia, São Paulo, and National Museum of Natural History, Washington, D.C. (USNM).

Hyla giesleri

The advertising call is intensity modulated, beginning relatively quietly and ending loudly. The call (Fig. 1A) consists of about 30 discrete pulses (two calls analyzed have 27 and 32 pulses) at an average pulse rate of about 100 per second. The duration of the entire call is about 0.3 s, and the du-

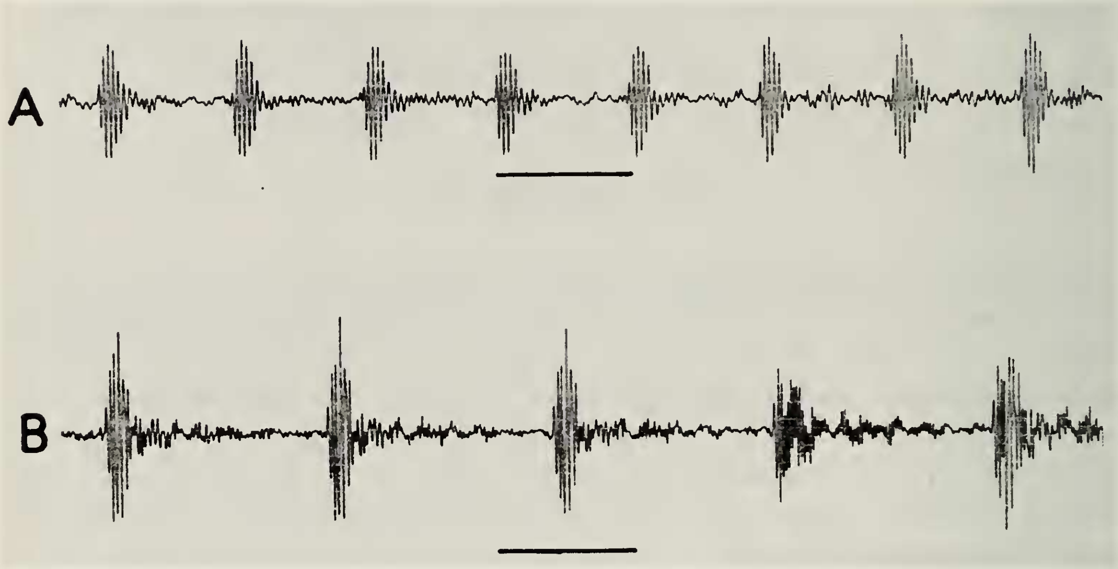

Fig. 1. Oscillographic strip chart recordings of portions of advertisement calls of (**A**) *Hyla giesleri* and (**B**) *Hyla microps*. Scale bars = 0.01 s. *Hyla giesleri* call from specimen USNM 208170 recorded at an air temperature of 20.5°C, Santa Teresa, Espírito Santo, Brazil. *Hyla microps* call from specimens USNM 208412-16 recorded at an air temperature of 19.5°C, Teresópolis, Rio de Janeiro, Brazil.

ration of individual pulses ranges from about 0.003 s at the beginning of the call to about 0.01 s towards the end of the call. The call has a complex spectral pattern, but does have a harmonic structure (Fig. 2A); the low frequency spectra presumably the fundamental (200–800 Hz range), and the high frequency spectra (3,000–3,800 Hz range) some multiple of the presumed fundamental. The dominant frequency at a temperature of 20.5°C ranges from a peak of about 3,000 Hz for the initial pulses in the call to a peak of about 3,600 Hz for the later pulses in the call.

The call of *H. giesleri* is similar to the call of *H. microps* in being pulsatile and having harmonic structure (Fig. 3). The calls differ distinctively in duration and dominant frequencies.

The call of *Hyla microps* is intensity modulated, starting out somewhat softly but quickly becoming and staying loud. The call consists of about 55–60 discrete pulses (Fig. 1B) at an average pulse rate of about 50 per second. The duration of the entire call is about 1 s, and the duration of individual pulses ranges from about 0.005 s for the initial pulses to about 0.01 s for pulses throughout the rest of the call. The call has a harmonic structure with a complex spectral pattern (Fig. 2B); it appears likely that the fundamental is in the 600–700 Hz range, with the dominant being the sixth harmonic. The dominant frequency at a temperature of 19.5°C ranges from about 4,600-5,300 Hz.

The recorded specimen of *Hyla giesleri* is part of a series taken at Santa

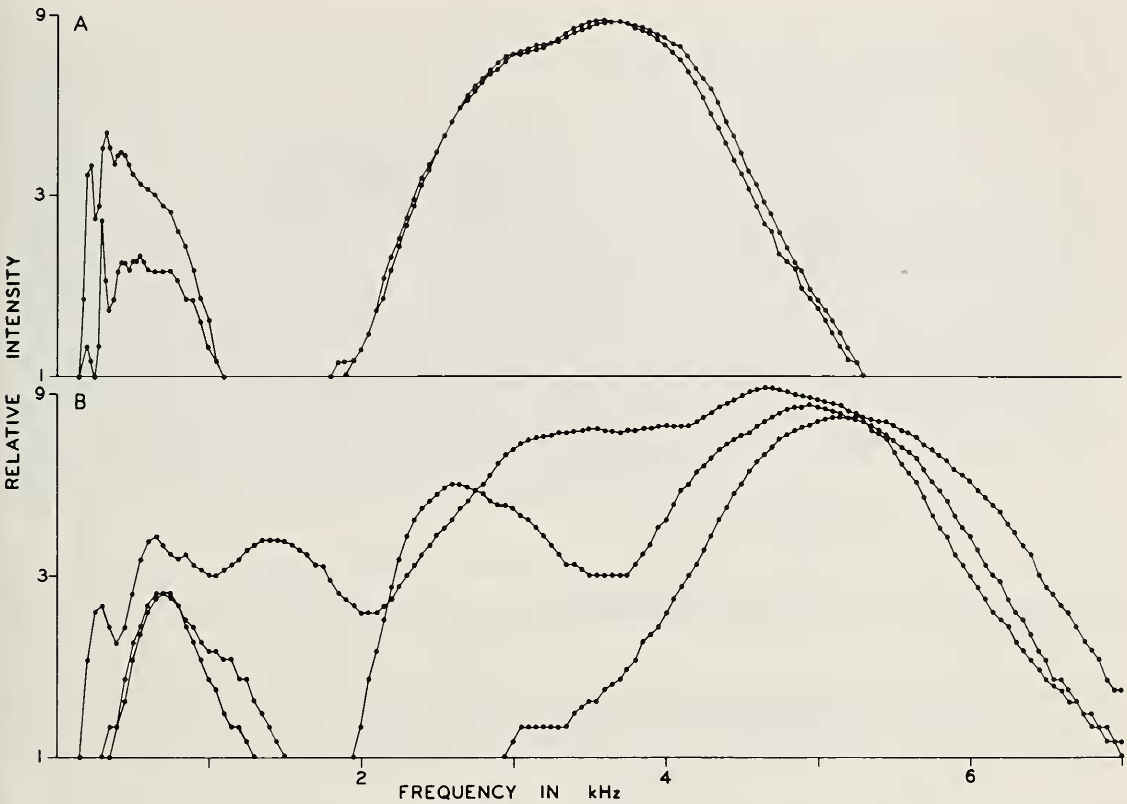

Fig. 2. Spectral analyses for advertisement calls of (**A**) *Hyla giesleri* (two calls) and (**B**) *Hyla microps* (three calls). The dots represent peak RMS meter readings at discrete frequency settings on the Brüel and Kjaer frequency analyzer, using a tape loop as the sound source. Specimen data same as for Fig. 1.

Teresa, Espírito Santo, Brazil. These specimens were compared with a topotype of *Hyla giesleri* at the USNM (taken by the collector of the type-specimens). Previously, *Hyla giesleri* had been reported only from the type-locality in the State of Rio de Janeiro, Brazil. Preserved specimens of *Hyla giesleri* are easily distinguished from those of *Hyla microps* by the presence in *H. microps* of a distinct white subocular spot or area on the upper lip. *Hyla giesleri* specimens lack a distinct white spot or area on the upper lip below the eye.

Ololygon opalina, new rank

The advertisement call begins quietly and builds in intensity. The call is pulsatile (Fig. 4A), but the pulses are not discrete. Because of the contrast in intensity between the beginning and ending of the call, only the louder ends of the calls appear on sonagrams (Fig. 5A). The entire call lasts about 0.7 s. Each pulse lasts about 0.03 s and is partially pulsed. The call has harmonic structure (Fig. 6A), with the sixth harmonic emphasized as the

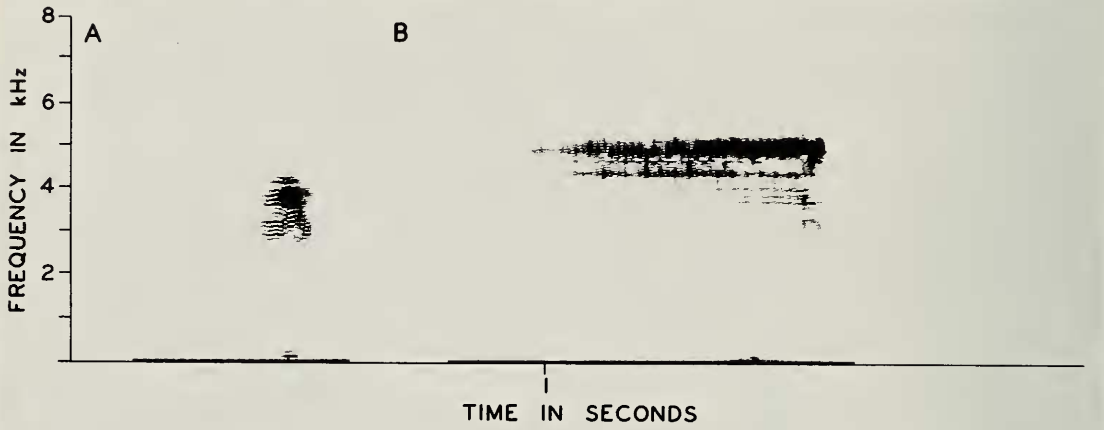

Fig. 3. Sonagrams (narrow band) of advertisement calls of (**A**) *Hyla giesleri* and (**B**) *Hyla microps*. Specimen data same as for Fig. 1.

dominant frequency. The dominant frequency at 15.8° C varies from 3,300 to 4,100 Hz.

The call of *O. opalina* is distinct from the call of *O. catharinae* from Santa Catarina. The calls have a general similarity in starting out quietly

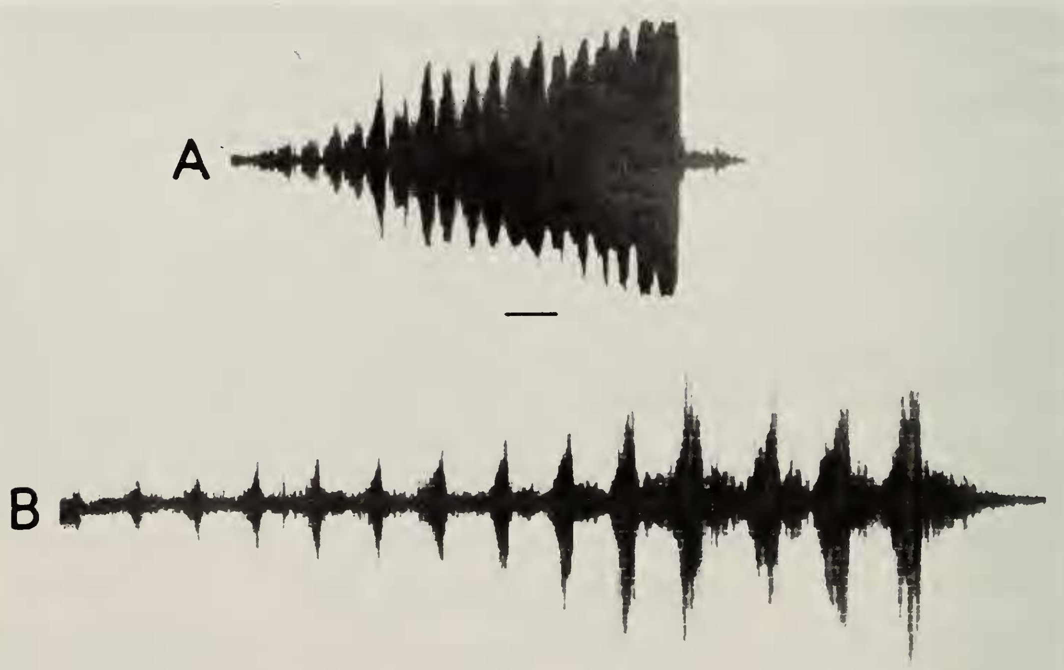

Fig. 4. Oscillographic strip chart recordings of advertisement calls of (**A**) *Ololygon opalina* and (**B**) *Ololygon catharinae*. Scale bars = 0.1 s. *Oloygon opalina* call from specimen USNM 208473 recorded at an air temperature of 15.8°C, Teresópolis, Rio de Janeiro, Brazil. *Ololygon catharinae* call from specimen USNM field no. 7359 recorded at an approximate air temperature of 22°C, Pirabeiraba, Santa Catarina, Brazil.

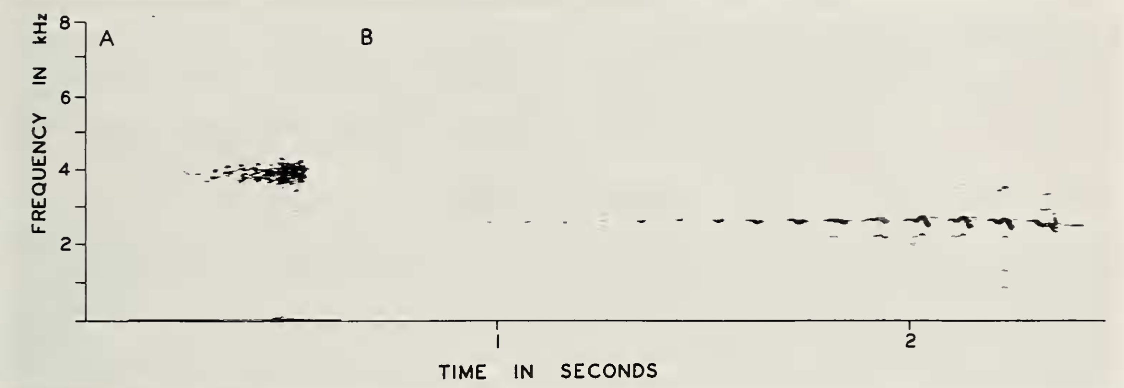

Fig. 5. Sonagrams (narrow band) of advertisement calls of (**A**) *Ololygon opalina* and (**B**) *Ololygon catharinae*. Specimen data same as for Fig. 4.

and ending relatively loudly, in being pulsatile, and in having harmonic structure. In several details, the calls differ markedly as can be seen when they are compared (Figs. 4, 5, 6).

The call of *O. catharinae* begins very quietly and ends much more loudly

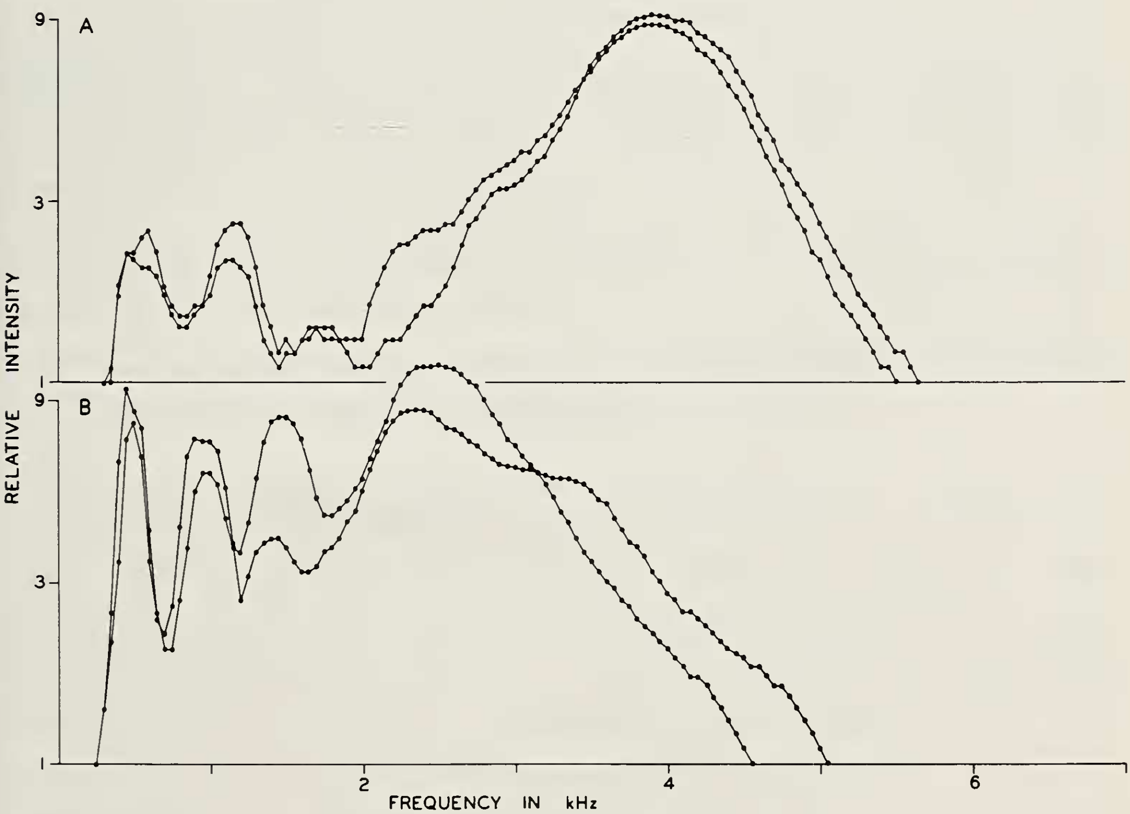

Fig. 6. Spectral analyses for advertisement calls of (**A**) *Ololygon opalina* (two calls) and (**B**) *Ololygon catharinae* (two calls). The dots represent peak RMS meter readings at discrete frequency settings on the Brüel and Kjaer frequency analyzer, using a tape loop as the sound source. Specimen data same as for Fig. 4.

(Fig. 4B). In the field, the first part of the call was not heard above the background of other chorusing frogs. Some frogs called from plastic bags after capture; only then was the first part of the call heard. The call consists of a number of separate pulses (Fig. 5B); each of the pulses has a relatively uniform intensity envelope, not distinctly pulsatile as in *O. opalina*. The entire call sequence lasts somewhat more than two seconds. The duration of a given pulse within the call lasts about 0.04 s. The pulses, particularly the latter, are frequency modulated (Fig. 5B). The call has harmonic structure (Fig. 6B), with either the fifth or sixth harmonic emphasized as the dominant frequency. The dominant frequency at about 22°C varies from 2,200 to 3,100 HZ.

The nominate subspecies of *O. catharinae* was described from the State of Santa Catarina, Brazil, where the recordings reported here were made. Lutz (1968) described a number of subspecies of *O. catharinae,* one of which (*simplex = obtriangulata*), she later (1973) raised to a full species. The call data presented here demonstrate that the subspecies Lutz (1973) defined as *catharinae* and *opalina* differ at the species level. There remain three subspecies as defined by Lutz (1973) for which the status is still unclear: *O. c. bocainensis, O. c. brieni, O. c. trapicheiroi.*

Specimens of *O. catharinae* and *O. opalina* are easily distinguished by color pattern. The dorsum of *O. opalina* is rather uniform; the groin region of bold dark and light markings contrasts markedly with the surrounding sides and dorsum (for a color photo, see plate V in Lutz 1973). The dorsum of *O. catharinae* consists of a series of alternating dark and lighter brown transverse bands (similar to those seen in *O. c. brieni* and *O. humilis* as photographed in plate V of Lutz 1973); the groin area has an intensification of the dorsal pattern, but there is no contrast between the dorsal and lateral pattern with the groin pattern.

Discussion

The species discussed represent morphologically similar species pairs. The morphological similarity presumably indicates close phyletic relationships. For each species pair, a common call pattern can be derived, yet there are at least three aspects of the calls for both species pairs where differences are sufficient to code species specific information. These differences are: (1) call duration, (2) pulse rate, and (3) dominant frequency channel. In addition, there is a pulsatile difference within notes for *O. catharinae* and *opalina* that could code species specificity. All of these call differences can be accounted for by relatively small adjustments in the calling apparatus. For example, differences in call duration and pulse rate are under neuromuscular control; small changes in behavior of this system could lead to the call differences seen. The frequency differences and pulsatile structure within note differences could be accounted for by small morphological changes in the vocal cords and/or vocal sac. Thus it appears that at least one premating isolating mechanism in frogs can evolve through fine tuning of a functional system; major changes are not required.

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